華僑中學

Hwa Chong Institution
Secondary 3 Examination (Practice B)

CANDIDATE NAME				
CLASS			REGISTER NUMBER	

Mathematics **2 hours**

Additional materials:

Writing papers

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on all the work that you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.

Answer **all** questions.
Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.
The use of an approved scientific calculator is expected, where appropriate.
For π, use either your calculator value or 3.142, unless the question requires the answer in terms of π.

You are reminded of the need for clear presentation in your answers.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

The total of the marks for this paper is 80.

This document consists of **7** printed pages.

Mathematical Formulae

Compound interest

$$\text{Total amount} = P\left(1+\frac{r}{100}\right)^n$$

Mensuration

$$\text{Curved surface area of a cone} = \pi r l$$

$$\text{Surface area of a sphere} = 4\pi r^2$$

$$\text{Volume of a cone} = \frac{1}{3}\pi r^2 h$$

$$\text{Volume of a sphere} = \frac{4}{3}\pi r^3$$

$$\text{Area of triangle } ABC = \frac{1}{2}ab\sin C$$

$$\text{Arc Length} = r\theta\text{, where } \theta \text{ is in radians}$$

$$\text{Sector area} = \frac{1}{2}r^2\theta\text{, where } \theta \text{ is in radians}$$

Trigonometry

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc\cos A$$

Statistics

$$\text{Mean} = \frac{\Sigma\ fx}{\Sigma\ f}$$

$$\text{Standard deviation} = \sqrt{\frac{\Sigma\ fx^2}{\Sigma\ f} - \left(\frac{\Sigma\ fx}{\Sigma\ f}\right)^2}$$

1 **(a)** Factorise completely $3x-6xy+4y^2-4y+1$. [3]

(b) Express as a single fraction in its simplest form $\left(x-\frac{15}{x}-2\right)\div\left(x+\frac{12}{x}+7\right)$. [3]

(c) It is given that $x=\sqrt{\frac{a^2-z^2}{z^2}}+y$ where $z\neq 0$. Express a in terms of x, y and z . [3]

2 **(a)** Solve the equation $\frac{1}{x}-\frac{3}{2x+1}=2$. [3]

(b) Solve the simultaneous equations $\frac{x^2-y}{x}=6=x+y$. [4]

3 A factory produces two types of toys – handmade and machine-made. The following table shows the cost of the components used in producing each toy.

	Labour (hours)	**Material (boxes)**	**Electricity (units)**
Handmade	8	5	0.7
Machine-made	3	5	0.4

(a) Represent the information given in the table as a 2×3 matrix **P**. [1]

(b) The labour costs $7 per hour, the material used costs $1.20 per box and electricity costs 60 cents per unit.

(i) Represent this information as a column matrix **C**. [1]

(ii) Evaluate the matrix **T** = **PC**. [2]

(iii) State what the elements in **T** represent. [1]

4 The function f is defined by $\mathrm{f}:x\mapsto 15+8x-2x^2$.

(i) Express $\mathrm{f}(x)$ in the form $a(x+b)^2+c$ where a, b and c are constants. [2]

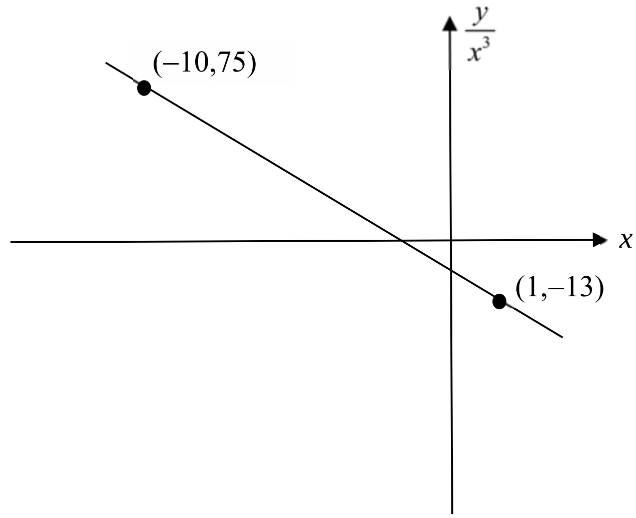
(ii) Hence, solve $15+8x-2x^2=0$. Leave your answers in exact form. [2]

(iii) State the equation of the line of symmetry of $\mathrm{f}(x)$. [1]

5 The diagram below shows a straight line obtained by plotting $\frac{y}{x^3}$ against x.

(i) Express y in terms of x. [3]

(ii) Amelia claims that the point $(5, -215)$ lies on the straight line. Is she correct? Justify your answer. [1]



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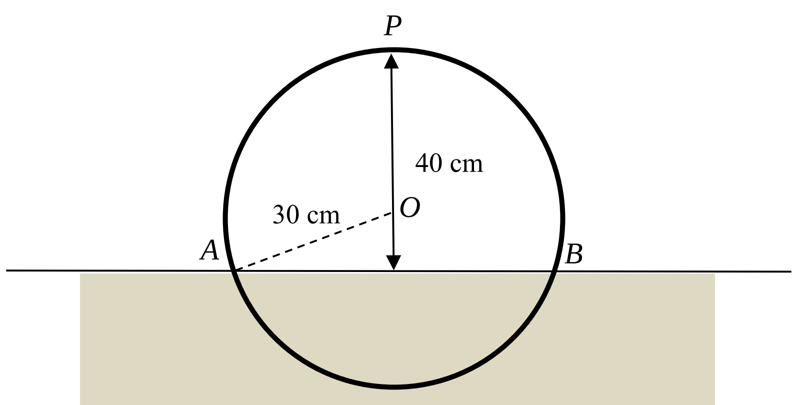


The diagram shows the cross section of a cylindrical barrel floating in water. The radius of the barrel is 30 cm and its highest point P is 40 cm above the water level AB. O is the centre of the circular face.

Calculate

(i) the angle AOB in radians, [2]

(ii) the major arc length APB, [2]

(iii) the percentage of the area of the barrel that is below the water level. [3]

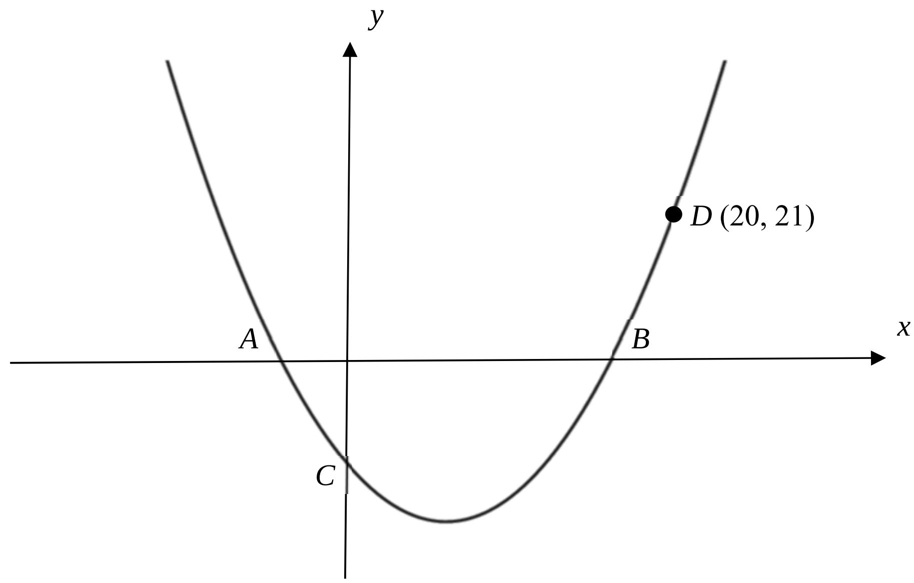
7 **(a)** The curve $y=(x+1)(x-k)$ cuts the x-axis at A and B, and y-axis at C.

It also passes through the point D (20, 21). Find

(i) the value of k, [2]

(ii) the area of triangle ABC, [2]

(iii) the equation of the straight line parallel to CD and passing through A. [2]



(b) Find the equation of the tangent at the point $A\left(\frac{2}{5}, 2\frac{4}{5}\right)$ on the circle

$x^2+y^2=2x+4y-4$. [4]

8 A straight line passing through the point $(1,4)$ intersects the curve $y^2+6x^2-7xy=0$

at $P\left(\frac{1}{2},3\right)$. Find

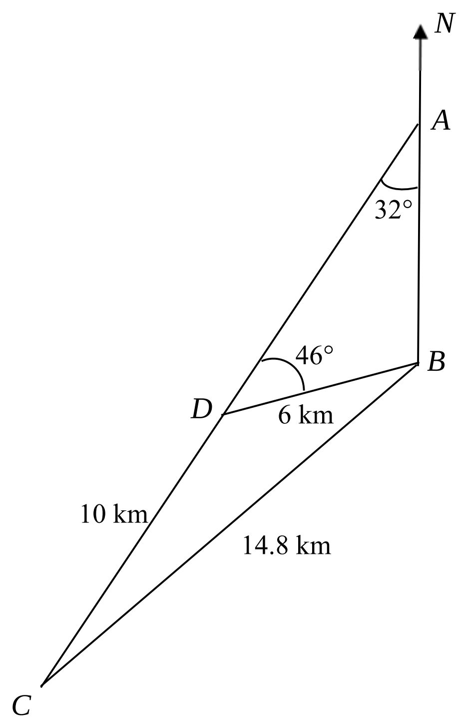
(i) the coordinates of the point Q at which the line meets the curve again, [4]

(ii) the equation of the perpendicular bisector of PQ. [2]

9 **(i)** Given that $\mathrm{f}(x)=\ln x$ and $\mathrm{g}(x)=-4\ln(x+3)$, describe the transformation of the graph $\mathrm{f}(x)$ in two successive steps. [3]

(ii) Sketch the graph of $y=-4\ln(x+3)$, indicate clearly the asymptote, y-intercept and x-intercept. [3]

10 The diagram shows points A, B, C and D on level ground, with A due North of B.



Given that angle $BAD = 32^\circ$, angle $ADB = 46^\circ$, $BD = 6$ km, $BC = 14.8$ km and $CD = 10$ km, calculate

(i) angle DBC, [2]

(ii) bearing of B from C, [2]

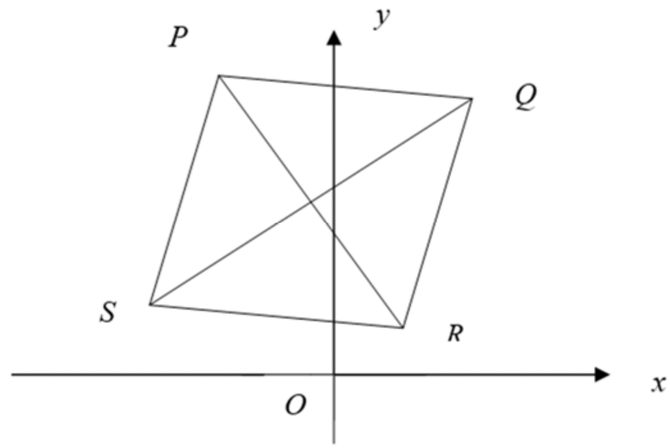
(iii) shortest distance from D to BC. [2]

TD represents a vertical tower. The angle of elevation of T from B is 47.5°, find

(iv) the height of the tower (correct to the nearest metres), [2]

(v) the maximum angle of elevation of the top of the tower T when observed along BC. [2]

11 In the figure, *PQRS* is a rhombus, with vertices $P(-3,14)$ and $Q(9,13)$. The diagonals of the rhombus intersect at $T(-1,9)$.



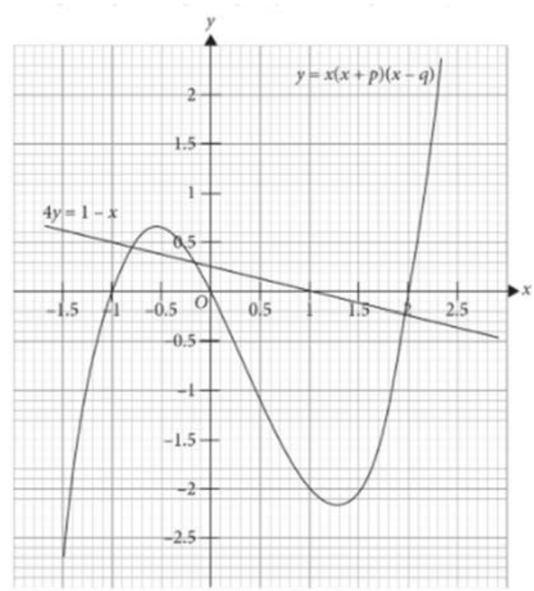
(i) Find the coordinates of S and of R. [4]

(ii) Hence, find the area of rhombus *PQRS*. [3]

12 The graphs of $y = x(x+p)(x-q)$, where p and q are positive integers, and $4y = 1 - x$ are drawn on the same axes as shown in the diagram below.

(a) State the values of p and of q. [2]

(b) The points of intersection of the curve and the straight line give the solutions of the cubic equation. Using your answer in (a), find the cubic equation, express your answer in the form $4x^3 + bx^2 + cx + d = 0$. [2]



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